

SPECIFICATIONS

ELECTRON BEAM THIN FILM EVAPORATION SYSTEM WITH IN-SITU ANGLED EVAPORATION CONTROL

The Naval Research Laboratory (NRL) has a requirement for an Electron Beam Thin Film Evaporation System with In-Situ Angled Evaporation Control. The system will be used to perform precise multi angle evaporations of the materials with multi-level resist pattern as well as routine metal depositions. Materials to be evaporated include all common metals used in semi-conductor fabrication and other insulating materials (e.g. MgO, SiO, AlO etc). The system shall be a cryo-pumped semi-automatic electron beam evaporator with a rotating, tilting and cooling substrate holder. The system shall be designed with two types of substrate holders and these holders shall be interchangeable. The primary substrate holder shall be designed for specific angle, off normal evaporation for edge shadowing which can be repositioned in vacuum along with continuous rotating and liquid nitrogen cooling capabilities. The secondary holder shall be a planetary for holding multiple wafers with rotating and rolling on a track. The evaporation system shall meet or exceeds the following specifications:

A. General Configuration:

Electron-beam evaporator, 6KW, 6 pocket source, special motion cryo substrate holder, interchangeable planetary 3 dome holder, auxiliary filament resistance sources, cryogenic pumping, vacuum automation, automatic deposition control.

- Chamber: Cylindrical stainless steel (SS) belljar 20 inches in inner diameter and 30 inches high with removable top plate
- Viewport with minimum 4 inches in diameter (The position of viewport shall be aligned to allow unobstructed view of crucible and it should be shuttered)
- Removable cylindrical chamber liners with pins and slots for tool-less removal (minimum 2) and shutter
- Baseplate 22 inches diameter, 10 feedthroughs and 6 inches pump port and fixturing blind tapped holes. Welded spool piece and debris screen
- Hoist: Electric, screw-jack, positive control with manual up-down, overrun protected
- Heater: (for chamber water desorption or heating) Dual, 1kW quartz lamp assemblies with thermocouple controller, Nominal range at substrates, ambient to 300C. Baseplate mounted
- Main chassis and chamber including hoist should fit in 6 feet wide 4 feet deep and 11 feet high space excluding cryo compressor and a forepump

B. Pumping System:

The pumping system shall include:

- Cryo-pump: 8 inches in diameter (1200 l/s or better)
- Mechanical pump (17 cfm or better)
- High vacuum valve: 6 inches electropneumatic gate valve, Viton flange seals
- Roughing valves: bellows-sealed electropneumatic right angle valves

The pumping system shall perform:

- Initial cool down after regeneration, less than 90 minutes
- Chamber roughing, less than 5 minutes
- Time to achieve 1×10^{-6} torr usual process base pressure, less than 20 minutes
- Base pressure 1×10^{-7} torr
- Pump base pressure: 1×10^{-10} torr
- Source cool down after evaporation: less than 5 minutes for e-beam source, less than 1 minute for filament
- Vent time: less than 5 minutes

C. Substrate Holders:

The primary and the secondary holders shall be interchangeable without any hardware modifications.

1. Primary Holder:

The primary substrate holder assembly shall be designed for edge-shadowing, cryo-cooled rotating, tilting platen, 10 inches diameter. Capacity of four 3 inches wafers.

The primary substrate holder shall include:

- Adjustable multi-stage rotary feedthrough for mounting substrate carrier
- Detachable liquid nitrogen line and feedthrough
- Carrier rotates 360 degrees about vertical and rotates to a specific desired angle under vacuum
- Rotation reverses after each revolution (motorized speed with 0-30 rpm)
- Ability to tilt 0-180 degrees with respect to angle of incidence of the evaporant under vacuum

- Tilt adjustable to a desired angle under vacuum with micrometer scale
- Ability to cool sample from 77K to ambient, using liquid nitrogen (LN2) and thermocouple control
- Ability to heat samples to 200C

2. Secondary Holder:

- Planetary, (3) domes, nominal 18 inches diameter with heat sinks
- Domes for capable of holding 12 3 inches wafers with both nests and spring-clip mounts option
- Stainless Steel construction, interchanges with primary substrate holder

D. Evaporation Sources:

1. Electron Beam Source: (for the purpose of semi-automatic process control)

- Water cooled 6-pocket electron beam sources (15 cubic centimeter (cc) per pocket) with 6 reducers for 7cc capacity
- 9 inches long and 5.1 inches wide gun with bottom control (270 degree deflection)
- 6kW power supply, 8kV at 800mA
- A beam sweep with remote operability
- Automatic indexer
- Rate and thickness controller package with dual crystal head for semi automatic process control

2. Filament Resistance Evaporation Source:

Filament Resistance Evaporation Source shall include:

- Four 400A boat/filament holders, for two sources
- 2kW, 400A at 5Vac power supply, manual or automatic
- Manual high current source switch
- Shutter for filament evaporation sources

E. Instrumentation:

Instrumentation shall consist of Vacuum system controller, Pressure gauges, e-beam controller and rate and thickness controller with dual crystal heads.

The vacuum system controller shall include:

- Integrated unit designed for Granville-Phillips type digital gauges (It is internally a programmable logic circuit (PLC) with minimum 12 outputs, 3 of which are user-definable, and has a diagrammatic front panel with lamps and switches and full manual control behind the front panel for troubleshooting and maintenance)
- Ability to regenerate cryo operation with re-programmable capability by user for process related functions